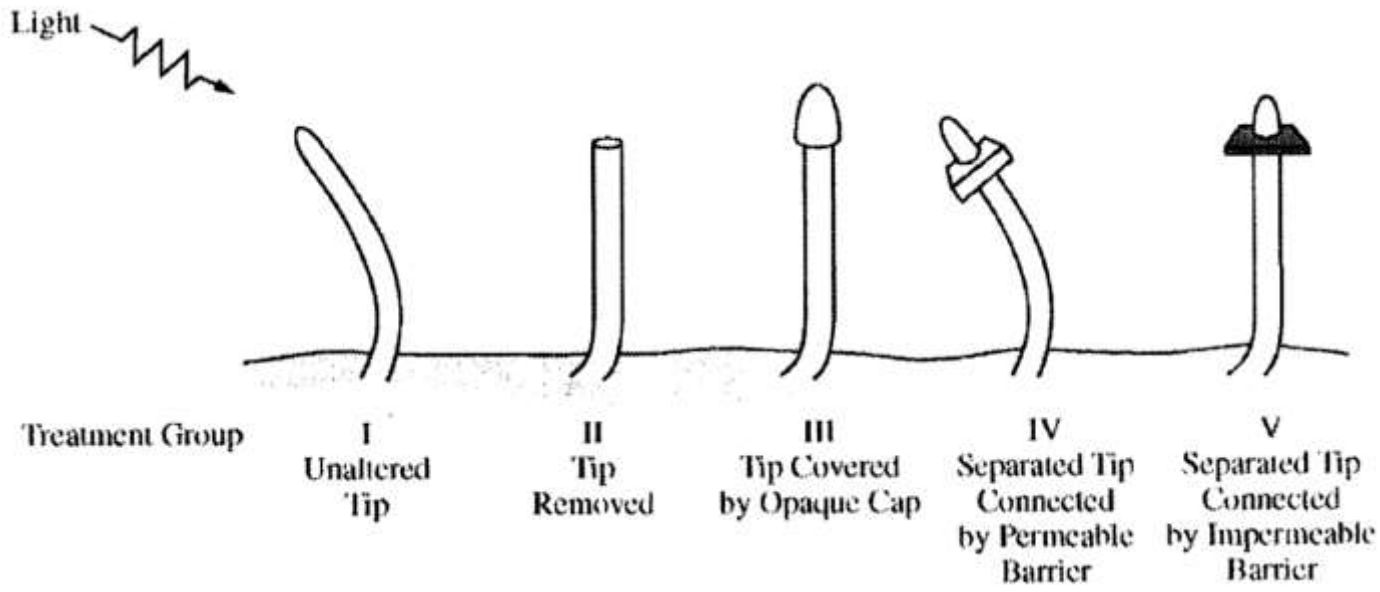
Responses & Behavior FRQ Practice

1.



Phototropism in plants is a response in which a plant shoot grows toward a light source. The results of five different experimental treatments from classic investigations of phototropism are shown above.

(a) **Give support** for the claim that the cells located in the tip of the plant shoot detect the light by comparing the results from treatment group I with the results from treatment group II and treatment group III.

(b) In treatment groups IV and V, the tips of the plants are removed and placed back onto the shoot on either a permeable or impermeable barrier. Using the results from treatment groups IV and V, **describe** TWO additional characteristics of the phototropism response.

2. Use the data on the bottom of this page and the following page to answer the 4 prompts below.

(b) Based on an analysis of the data in Figure 2, **describe** the activity pattern of the mice during the light and dark periods of the L12:D12 cycle.

(c) The researchers claim that the genetically controlled circadian rhythm in the mice does not follow a 24-hour cycle. **Describe** ONE difference between the daily pattern of activity under L12:D12 conditions (Figure 2) and under DD conditions (Figure 3), and use the data to **support** the researchers' claim.

(d) To investigate the claim that exposure to light overrides the genetically controlled circadian rhythm, the researchers plan to repeat the experiment with mutant mice lacking a gene that controls the circadian rhythm. **Predict** the observed activity pattern of the mutant mice under L12:D12 conditions and under DD conditions that would support the claim that light overrides the genetically controlled circadian rhythm.

(e) In nature, mice are potential prey for some predatory birds that hunt during the day. **Describe** TWO features of a model that represents how the predator-prey relationship between the birds and the mice may have resulted in the evolution of the observed activity pattern of the mice.

Researchers investigated the effect of light on mouse behavior by using a running wheel with a motion sensor to record activity on actograms, as shown in Figure 1.

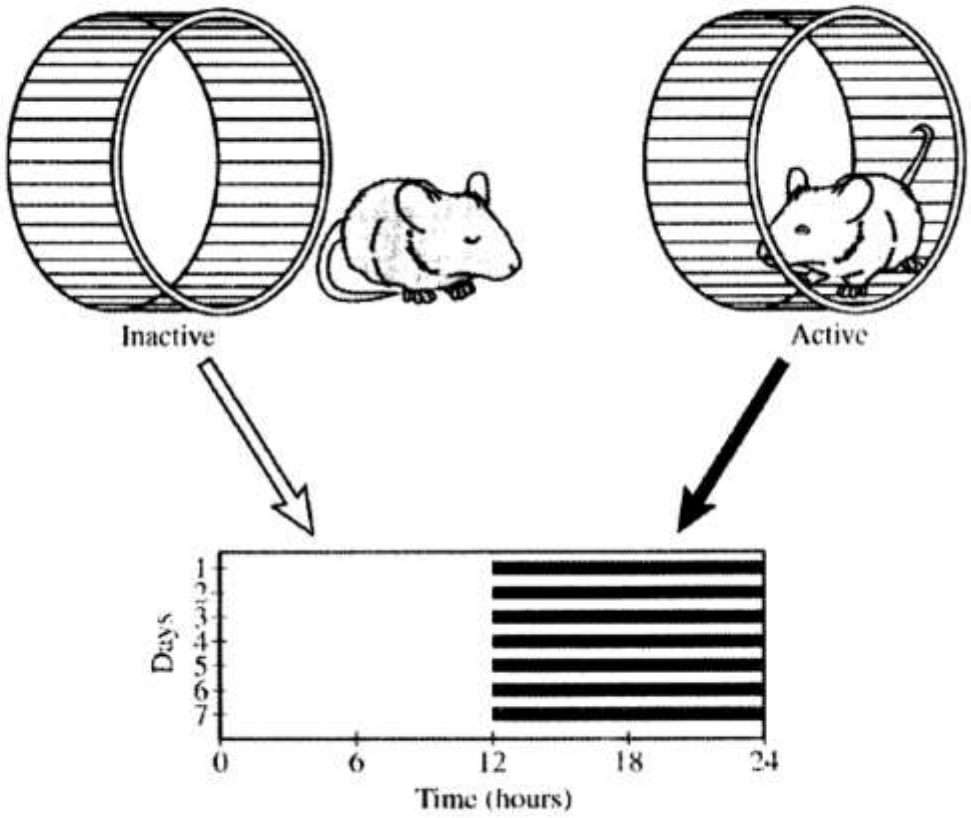


Figure 1. Strategy for recording mouse activity data. When a mouse is active on the running wheel, the activity is recorded as a dark horizontal line on an actogram. When the mouse is inactive, no dark line is recorded.

For the investigation, adult male mice were individually housed in cages in a soundproof room at 25°C. Each mouse was provided with adequate food, water, bedding material, and a running wheel. The mice were exposed to daily periods of 12 hours of light (L) and 12 hours of dark (D) (L12:D12) for 14 days, and their activity was continuously monitored. The activity data are shown in Figure 2.

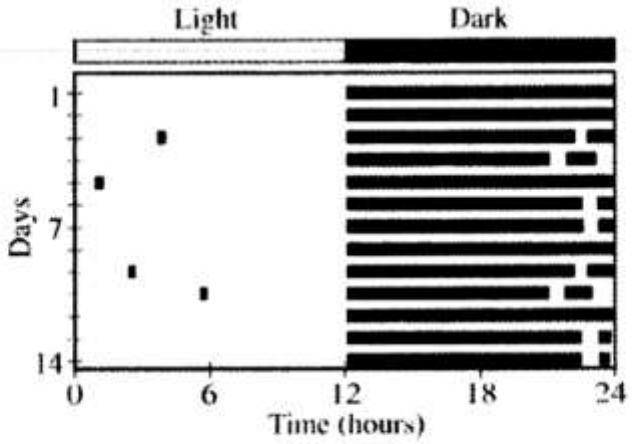


Figure 2. Actogram of mouse activity under L12:D12 conditions. Each row represents a 24-hour period, and the dark horizontal lines represent activity on the running wheel.

After 14 days in L12:D12, the mice were placed in continuous darkness (DD), and their activity on the running wheel was recorded as before. The activity data under DD conditions are shown in Figure 3.

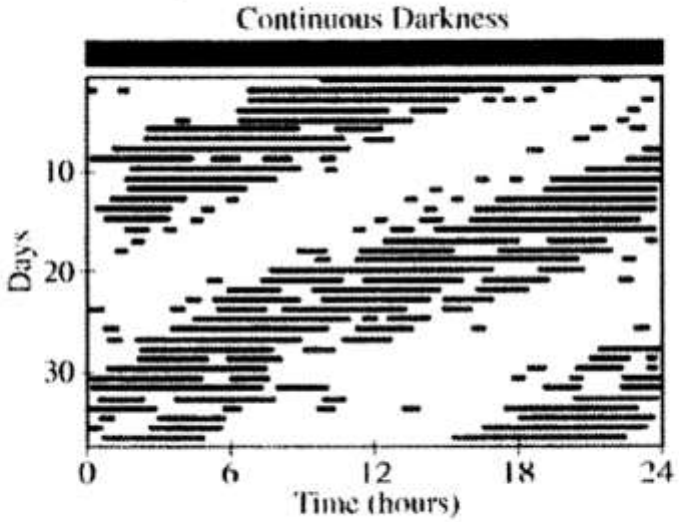


Figure 3. Actogram of mouse activity under DD conditions. Each row represents a 24-hour period, and the dark horizontal lines represent activity on the running wheel.

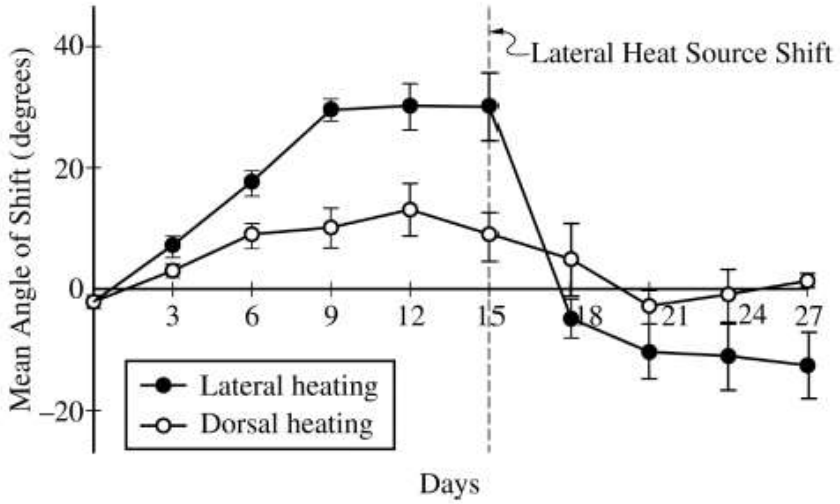


Figure 1. Mean angle of the shift in turtle embryo position following exposure to a directional heat source. The error bars represent $\pm 2SE_{\bar{x}}$.

3. A certain species of turtle (*Pelodiscus sinensis*) lays its eggs in nests that are buried in the sand. The turtle then leaves the eggs to develop. A researcher claims that turtle embryos are able to shift within their eggs in response to directional thermal cues in the environment. To test the claim, the researcher incubated turtle eggs in containers and used heating pads to deliver heat either to the top of the container (dorsal heating) or to one side of the container (lateral heating). The position of the lateral heat source was switched from one side to the other on day 15. The researcher recorded the shifts in embryo position relative to the initial embryo position in the egg. The results are shown in Figure 1.

   (a) **Indicate** whether the researcher's claim that turtle embryos within their eggs respond to thermal cues is supported or not supported. Using the data, **justify** your response.

   (b) The researcher used the dorsal heat treatment as the control. **Propose** a different treatment that would have been another valid control.

   (c) The researcher hypothesizes that when turtle embryos respond to thermal cues they develop more rapidly than do turtle embryos that do not respond to thermal cues. **Describe** ONE potential advantage for turtles having a shorter embryonic period.